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(54) **Pressure relieving regulators**

(57) A regulator for pressure relief purposes comprises a spring loaded diaphragm (22) which lifts when an excess pressure develops at the regulator inlet (42), thereby to open a valve (30, 36) allowing escape of fluid at the regulator outlet (46). A valve control unit (12) is interposed between the diaphragm and the valve and is arranged in such a way that a valve member (36) lifts to open the valve under a substantially reduced fluid pressure compared to that required to lift the diaphragm.

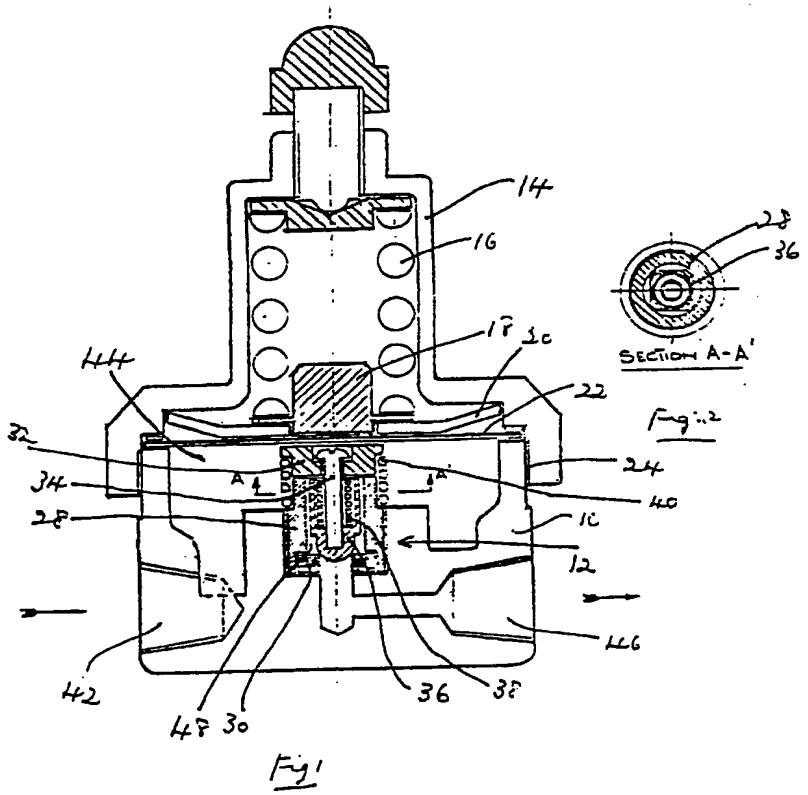

Fig 1

Fig 2

The claims were filed later than the filing date within the period prescribed by Rule 25(1) of the Patents Rules 1990.

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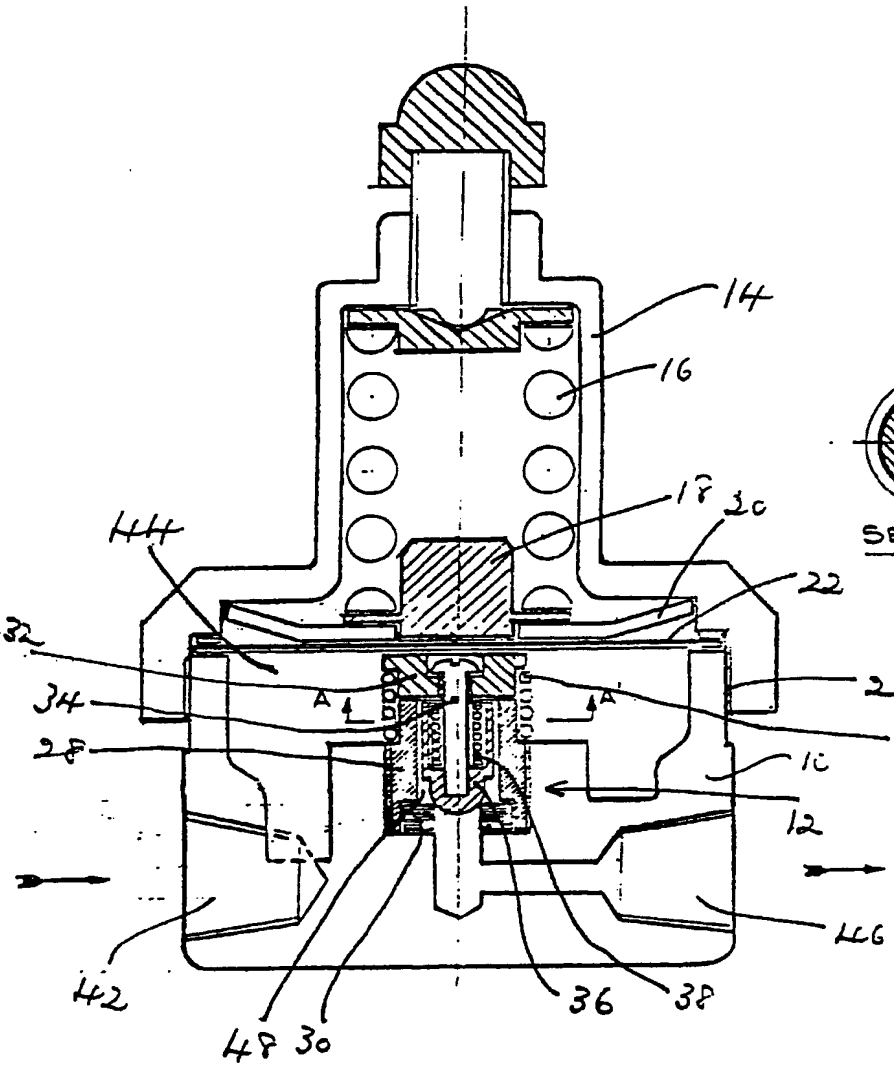
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A'

Fig 1

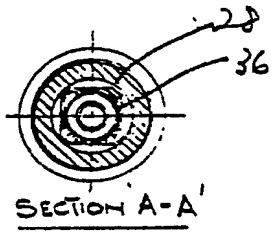
28
36
SECTION A-A'

Fig 2

Improvements in Relieving Regulators

This invention relates to a relieving regulator.

One particular application of relieving regulators is for pressure relief on containers which store cold liquefied gases such as nitrogen and argon under high pressure.

In use, when consumption of the gas occurs and environmental temperatures are liable to rise, increased evaporation of the liquefied gas within the container frequently leads to operation of the relief valve.

In a conventional relieving regulator for a cold environment, a spring loaded diaphragm usually acts directly against a valve member of PTFE or equivalent material which closes directly against the valve seat. At the very cold temperature of the gas involved, and the very high pressure acting on the diaphragm, even the special material employed for the valve member is not able to withstand frequent operations, and severe deterioration of the valve member results, sufficiently eventually to lead to the situation where the relief valve does not properly re-close, thus giving rise to constant gas leakage. It is an object of the present invention to overcome this problem.

However, the invention is not limited to cold temperature applications of a relieving regulator. The above-described conventional regulator with a diaphragm acting directly on the relief valve has a very large operational tolerance, and is liable to operate anywhere in the range of ±10% of a nominal predetermined excess fluid pressure. Another object of the present invention is to provide a relieving regulator, useful

for pressure relief in any of a wide variety of applications involving working liquids or gases, which has a substantially reduced operational tolerance.

According to the invention, there is provided a relieving regulator having a spring loaded diaphragm which lifts when an excess fluid pressure of a substantially predetermined value develops at the regulator inlet, thereby to open a valve in order to allow escape of fluid at the regulator outlet, wherein the diaphragm is spring loaded against a displaceable valve assembly which is itself spring loaded against the diaphragm on the same side thereof as the fluid inlet pressure, the valve assembly including a valve member which is spring urged away from the diaphragm against a valve seat through which fluid can escape via the valve assembly when the diaphragm is lifted, the arrangement being such that the valve member is loaded against the valve seat with a substantially lower pressure than the predetermined pressure required to lift the diaphragm.

Further features and advantages of the invention will be apparent from the following description of an embodiment of relieving regulator, making reference to the accompanying drawings, in which:-

Figure 1 shows the regulator in axial cross-section; and

Figure 2 is a cross-section on the line A-A of Figure 1.

The illustrated regulator comprises a valve housing 10 containing a valve unit generally referenced 12 and a hollow cap 14 housing a strong spring 16 which bears through a spacer 18 and spring washer 20 against a diaphragm 22 held trapped at its periphery between the housing and the cap.

The hollow cap 14 fits to the housing 10 by means of a screwthread 24, whereby the spring 16 can be adjusted to permit the diaphragm 22 to lift under a predetermined fluid pressure applied to the face of said diaphragm directed towards the inside of the housing.

The valve unit 12 is disposed on the axial centre of the diaphragm 22, and comprises a guide sleeve 28 and valve seat 30, together with a displaceable valve assembly comprising a diaphragm abutment member 32, a central screwthreaded pin 34, a valve member 36 into which the pin 34 is screwed, and a light spring 38 which urges the valve member away from the abutment member 32 against the fixed valve seat. The abutment member 32 is urged upwardly relative to the fixed part of the valve unit towards the diaphragm by a light spring 40 stronger than the spring 38. Normally, however, the strong spring 16 in the cap 14 causes the diaphragm to bear down on the displaceable valve assembly with a substantially greater pressure than the upward pressure applied by the spring 40, so that the displaceable valve assembly is pressed down against the fixed part of the valve unit. Valve member 36 within the displaceable valve assembly is closed against the valve seat with the substantially lighter pressure of the spring 38.

Fluid inlet 42 to the housing 10 allows fluid under pressure to enter an annular chamber 44 surrounding the valve unit in order to cause the pressure of said fluid to be applied to the face of the diaphragm directed towards the housing, whereby an excess fluid inlet pressure exceeding the set predetermined value will cause the diaphragm to lift. Fluid outlet 46 from the housing 10 connects with the valve seat 30.

When in use the diaphragm 22 lifts under an excess of fluid

inlet pressure, the movable valve assembly excluding the valve member 36 lifts under the action of spring 40, so maintaining engagement of the member 32 with said diaphragm. Spring 38 initially maintains the valve member 36 closed against the valve seat 30. However, when the diaphragm abutment member 32 lifts, fluid from the chamber 44 is able freely to enter the valve assembly beneath said member 32, and pass down the outside of the valve member 36 within the guide sleeve 28 to reach a small chamber 48 existing at a reduced diameter hemi-spherical lower end of the valve member closed against the valve seat. A square cross-sectional shape of the main portion of the valve member 36, shown in Figure 2, enables free passage of the fluid into this small chamber 48.

When abutment member 32 lifts, it lifts central pin 34, in turn lifting the valve member 36, thus allowing pressure relief by escape of fluid to the outlet 46. As fluid can also enter the interior of the valve member around the spring 38, the resultant upward pressure acting in the region of the valve seat 30 is relatively small, being only a small fraction of the excess pressure which has caused the diaphragm to lift. Moreover, the set pressure of the spring 38 normally acting to close the valve member 36 against the valve seat can be correspondingly small, so that the valve member and valve seat are subject to much reduced deterioration and wear, even in low temperature applications of the regulator. Moreover, the overall operating tolerance of the regulator is reduced. It will be appreciated that the gas pressure to hold the diaphragm down is transmitted to the fixed part of the valve unit (sleeve 28); however, in a practical example, the region of the valve seat is exposed to gas pressure over an equivalent area of only 0.17 cm^2 (0.027 sq. inches)

additional to the pressure of light spring 38.

Either one or both of the valve member 36 and the valve seat 30 may be made of a hard wear resistant material such as PCTFE, especially for low temperature applications.

Various modifications of the above-described and illustrated arrangement are possible within the scope of the invention hereinbefore defined.

Claims

1. A relieving regulator having a spring loaded diaphragm which lifts when an excess fluid pressure develops at the regulator inlet, thereby to open a valve in order to allow escape of fluid at the regulator outlet, wherein a valve assembly is interposed between the diaphragm and the valve to pass fluid towards the valve when the diaphragm is lifted, the fluid passed through the valve assembly acting on a valve member with a substantially reduced pressure compared with that acting on the diaphragm in order to cause the valve to open.

2. A relieving regulator having a spring loaded diaphragm which lifts when an excess fluid pressure of a substantially predetermined value develops at the regulator inlet, thereby to open a valve in order to allow escape of fluid at the regulator outlet, wherein the diaphragm is spring loaded against a displaceable valve assembly which is itself spring loaded against the diaphragm on the same side thereof as the fluid inlet pressure, the valve assembly including a valve member which is spring urged away from the diaphragm against a valve seat through which fluid can escape via the valve assembly when the diaphragm is lifted, the arrangement being such that the valve member is loaded against the valve seat with a substantially lower pressure than the predetermined pressure required to lift the diaphragm.

3. A regulator as claimed in claim 2, in which, on displacement of the valve assembly when the diaphragm is lifted, fluid is able to pass through the valve assembly into a lifting chamber within which is developed a pressure sufficient to lift the valve member from the valve seat.

4. A regulator as claimed in claim 3, in which the valve member is hollow, and fluid is also able to enter the interior of said valve member partially to counter the lifting pressure developed in the lifting chamber.

5. A regulator as claimed in claim 3 or claim 4, in which the lifting chamber is located at the end of the valve member engaging the valve seat, said end of the valve member being hemi-spherically domed.

6. A regulator as claimed in claim 5, in which the lifting chamber is an annular chamber defined on the inside by the domed end of the valve member, on the outside by a fixed sleeve relative to which the valve assembly is displaceable, at one end by the valve seat, and at the other end by an annular shoulder on the valve member.

7. A regulator as claimed in claim 6, in which the fixed sleeve has a circular interior cross-section and the valve member has a shank of square cross-section slidable in the sleeve, whereby fluid is enabled to enter the annular chamber between said fixed sleeve and said shank of the valve member.

8. A regulator as claimed in any of claims 4 to 7, in which, internally, the valve member is mounted on a pin forming part of the displaceable valve assembly and which positively prevents the valve member from lifting except when the valve assembly is displaced as a consequence of lifting of the diaphragm.

9. A regulator as claimed in claim 8, in which the spring acting on the valve member is located around the pin, and acts between said valve member and a diaphragm abutment

member to which the pin is fixed.

10. A regulator as claimed in claim 9 when appendant to claim 6, in which the spring acting on the displaceable valve assembly acts between the fixed sleeve and the abutment member.

11. A regulator as claimed in any of claims 2 to 10, in which the spring which acts on the displaceable valve assembly is a stronger spring than that which acts on the valve member.

12. A regulator as claimed in any of claims 1 to 11, in which the spring loading of the diaphragm is adjustable to set the predetermined fluid pressure at which the diaphragm lifts.

13. A relieving regulator substantially as hereinbefore described with reference to the accompanying drawing.

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